

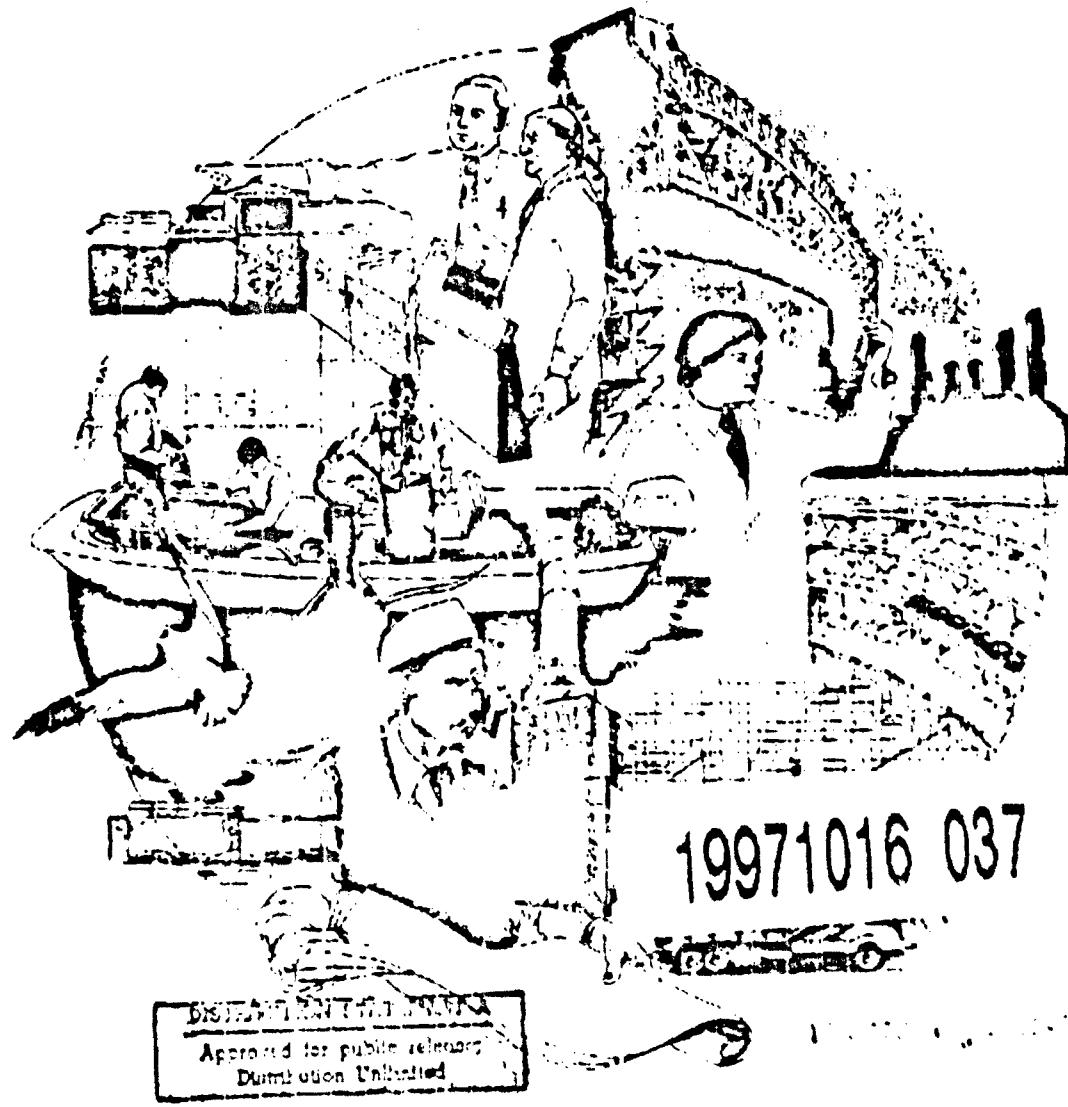
WESTON

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Energy Engineering
Analysis Program (EEAP)
Final Report
Volume I: Executive
Summary

January 1983

Military Ocean Terminal
Bayonne, New Jersey (MOTBY)
Department of the Army
Contract No. DACA65-81-C-0020



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ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

INCREMENTS A, B, AND C

at the

MILITARY OCEAN TERMINAL
Bayonne, New Jersey
(MOTBY)

FINAL REPORT

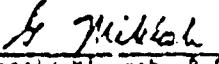
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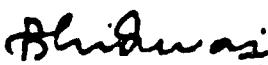
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Under Contract No. DACA65-81-C-0020

January 1983


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SECTION I

INTRODUCTION

As a result of the specific requirements of Increments A, B, and C of Contract No. DACA65-81-C-0020, WESTON has performed an extensive energy engineering analysis of various facilities at the Military Ocean Terminal, Bayonne, New Jersey (MOTBY). The analysis has included the following:

1. Site surveys.
2. Examination and inspection of system drawings.
3. Development of mechanical equipment lists.
4. Identification of equipment capacities and building loads.
5. Determination of utility energy consumption quantities and prices.

The study has similarly included the development and evaluation, according to U.S. Army ECIP criteria, of various energy conservation measures (ECM's). A significant number of preliminary opportunities were considered. Based on extensive review and consideration of total MOTBY operations, a final consensus listing was identified and detailed evaluations performed. This report lists the results of the detailed evaluation of the energy conservation measures and presents them as proposed ECIP projects. In addition, historical basewide energy consumption and the energy savings and energy cost savings based on implementation of the identified projects is included.

SECTION 2

EXISTING ENERGY CONSUMPTION

2.1 BASEWIDE CONSUMPTION

Total basewide energy consumption according to fuel type for FY79 is summarized in Table 2-1. Partial records indicate that total energy consumption for baseline year FY75 was 979,200 MBtu (millions of Btu).

Table 2-1

Basewide Energy Consumption by Fuel Type - FY79

<u>Fuel Type</u>	<u>Fuel Unit</u>	<u>FY79 Consumption</u>
Electricity	kWh	25,019,960
No. 6 Fuel Oil	Gal.	3,718,470
No. 2 Fuel Oil	Gal.	114,576
Natural Gas	Therm	12,339
Propane Gas	Gal.	3,819
No. 2 Diesel Fuel	Gal.	36,834
Gasoline	Gal.	94,248

Table 2-2 below lists the energy conversion factors for the various fuels used at MOTBY. This list is consistent with the values given in Section 8 of ECIP Guidance dated 10 November 1980:

Table 2-2

Energy Conversion Factors

<u>Fuel</u>	<u>Fuel Unit</u>	<u>Conversion Factor</u>	<u>Conversion Factor</u> <u>in MBtu</u>
Electricity	kWh	11,600 Btu/kWh	0.0116 MBtu/kWh
No. 6 Fuel Oil	Gal.	149,600 Btu/Gal.	0.1496 MBtu/Gal.
No. 2 Fuel Oil	Gal.	138,700 Btu/Gal.	0.1387 MBtu/Gal.
Natural Gas	Therm (10^5 Btu)	1,031,000 Btu/1,000 ft ³	0.1000 MBtu/Therm
Propane	Gal.	95,500 Btu/Gal.	0.0975 MBtu/Gal.
No. 2 Diesel Fuel	Gal.	149,700 Btu/Gal.	0.1497 MBtu/Gal.
Gasoline	Gal.	149,700 Btu/Gal.	0.1497 MBtu/Gal.

Table 2-3 below lists the unit energy costs for FY79 by fuel type. The origin of these costs are given in foot notes.

Table 2-3
Unit Fuel Costs: FY79

<u>Fuel Type</u>	<u>FY79 Average Unit Cost</u>	<u>Note</u>
Electricity	\$3.497/MBtu	1
No. 6 Fuel Oil	\$4.115/MBtu	2
No. 2 Fuel Oil	\$4.02/MBtu	3
Natural Gas	\$0.3825/Therm	4
Propane Gas	\$0.637/Gal.	5
No. 2 Diesel Fuel	\$4.35/MBtu	6
Gasoline	\$0.84/Gal.	7

¹Based on 85 percent of the 1980 average value of \$0.047725/kWh.

²Based on 70 percent of the January 1982 cost of \$0.88/Gal.

³Based on 70 percent of the January 1982 cost of \$0.85/Gal.

⁴Based on 70 percent of the January 1982 cost of \$0.355/Therm.

⁵Based on 70 percent of the January 1982 cost of \$0.91/Gal.

⁶Based on 70 percent of the January 1982 cost of \$0.92/Gal.

⁷Based on 70 percent of the January 1982 cost of \$1.20/Gal.

A summary of FY79 basewide energy consumption and costs by fuel type is given below in Table 2-4:

Table 2-4
Basewide Energy Consumption by Fuel Type - FY79

<u>Fuel Type</u>	<u>Quantity</u>	<u>Equivalent Btu</u>	<u>Cost</u>
Electricity	25,019,360 kWh	290,000 MBtu	\$1,014,000
No. 6 Fuel Oil	3,718,470 Gal.	557,000 MBtu	2,292,000
No. 2 Fuel Oil	114,576 Gal.	17,200 MBtu	69,144
Natural Gas	12,339 Therms	1,230 MBtu	4,790
Propane Gas	3,819 Gal.	571 MBtu	2,430
No. 2 Diesel Fuel	36,834 Gal.	5,510 MBtu	23,970
Gasoline	94,248 Gal.	14,100 MBtu	79,200
		805,611 MBtu	\$3,485,534

Table 2-5 summarizes the FY85 unit fuel costs for each fuel. These values are used as a basis for ECM evaluations, and are based on the November 1981 fuel bills. November 1981 fuel costs are given, and then converted to a uniform \$/MBtu unit cost for November 1981 using the conversion factors stated in Table 2-2. These values are escalated to FY85 using the annual escalation rates provided in "ECIP Guidance" of 20%/yr for natural gas and propane, and 15%/yr for all other fuels.

Table 2-5
Fuel Unit Costs Used in ECM Evaluation

<u>Fuel Type</u>	<u>Unit Cost per Fuel Unit November 1981</u>	<u>Unit Cost November 1981</u>	<u>Unit Cost FY85</u>
Electricity	\$0.063/kWh	\$5.88/MBtu	\$7.72/MBtu
No. 6 Fuel Oil	\$0.88/Gal.	\$5.43/MBtu	\$8.36/MBtu
No. 2 Fuel Oil	\$0.85/Gal.	\$6.13/MBtu	\$8.71/MBtu
Natural Gas	\$0.573/100 ft ³	\$5.56/MBtu	\$9.43/MBtu
Propane Gas	\$0.91/Gal.	\$9.53/MBtu	\$16.00/MBtu
No. 2 Diesel Fuel	\$0.88/Gal.	\$5.88/MBtu	\$8.36/MBtu
Gasoline	\$1.20/Gal.	\$8.02/MBtu	\$11.40/MBtu

2.2 TOTAL ANNUAL ENERGY USED

Table 2-6 below summarizes the total basewide energy use for FY75, FY79 and FY80, and also the energy costs for these years. No cost data is available for FY75.

Table 2-6

Total Annual Energy Use - FY75, FY79, and FY80

<u>Fiscal Year</u>	<u>Annual Energy Use (MBtu/yr)</u>	<u>Annual Energy Cost (\$/yr)</u>	<u>Use as % of FY75</u>	<u>Cost as % of FY75</u>
FY75	979,200	Data Not Available	100%	----
FY79	885,600	3,485,534	90.4%	100%
FY80	881,100	4,221,641	90.0%	121%

As shown in this table, FY80 energy consumption was only slightly less than FY79 consumption, and both are approximately 90% of the baseline FY75 consumption. To meet the stated goal of a 20% reduction of FY75 use by FY85, an additional 10% reduction (= 97,900 MBtu/yr) is required.

2.3 BUILDING GROUP ENERGY CONSUMPTION

Of the 43 buildings at MOTBY and 5 buildings of the Golosborough Village family housing area, 10 were chosen for detailed analysis for the Energy Engineering Analysis Program (EEAP) under a contract with Roy F. Weston, Inc. of West Chester, Pennsylvania. These buildings were chosen as representative of others, or as unique on the facility. Building 32 was later added to this group. In a separate contract for an EMCS feasibility study, which is part of the EEAP, the firm of V. L. Falotico of New York, NY completed an energy loads survey, the results of which are given in Table 2-7 below. Underlined buildings are those surveyed by Roy F. Weston, Inc. Building loads are given in units of thousands of Btu per hour, i.e. kBtu/hr.

Table 2-7

Building Design Heating Loads - Buildings Heated by Building 44-C Heating Plant

<u>Bldg. No.</u>	<u>Floor Area (ft.²)</u>	<u>65° Areas (kBtu/hr)</u>	<u>40-55° Areas (kBtu/hr)</u>	<u>Total</u>
IA	1,300	0	100	100

Table 2-7 - Continued

**Building Design Heating Loads - Buildings Heated
by Building 4L-C Heating Plant**

<u>Bldg. No.</u>	<u>Floor Area (ft²)</u>	<u>65° Areas (kBtu/hr)</u>	<u>40-55° Areas (kBtu/hr)</u>	<u>Total (kBtu/hr)</u>
11	61,700	24	1,519	1,543
12	121,400	65	3,090	3,155
13	121,400	44	3,111	3,155
14	121,400	65	3,090	3,155
15A	11,300	720	0	720
21/31	182,000	82	2,792	2,874
22	121,400	65	3,090	3,155
23	121,400	33	3,122	3,155
24	121,400	65	3,090	3,155
32	720,000	287	7,662	7,749
33	121,400	64	3,091	3,155
34	121,400	90	6,800	6,890
35	94,600	347	272	619
41	171,200	78	674	752
42	776,000	1,325	9,500	10,825
43	121,400	45	3,110	3,155
44A	22,600	270	638	908
44B	10,200	611	450	1,061
44C	9,300	44	301	345
44D	11,200	202	640	842
45	126,600	619	2,671	3,290
52A	13,300	426	0	426
52B	6,500	326	0	326
52C	5,100	176	0	176
53A	8,200	76	582	658
54	120,000	39	4,720	4,759
55	120,000	39	4,720	4,759
61B	4,900	482	0	482
63	120,000	39	4,720	4,759
64	120,000	39	4,720	4,759
72	60,800	1,946	0	1,946
72A	4,800	98	174	262
73	120,000	33	3,097	3,120
74	120,000	17	3,003	3,120
82	136,000	4,352	0	4,352
83A	6,000	531	0	531
100	192,400	2,499	0	2,499
101	158,600	5,075	0	5,075
105	10,800	0	535	535
108	11,700	575	0	575
110	3,300	288	0	288
111	5,700	438	0	438
Totals		4,638,800	22,729	84,874
				107,603

2.4 TYPICAL BUILDING ENERGY CONSUMPTION

Buildings chosen to be surveyed were done so on the basis of being representative of others on the facility. To extrapolate the ECM projects in the surveyed buildings to those not surveyed, Table 2-8 below was prepared, in which each extrapolated building is identified with a surveyed building on the basis of building construction, occupancy, and use. For extrapolation purposes, the ratio of floor areas of the extrapolated building to the similar surveyed building was calculated. This ratio was used as a multiplier to determine 1) project cost, 2) energy savings, and 3) energy cost savings for the extrapolated building.

Table 2-8

Building Extrapolation Factors

<u>Surveyed Buildings</u>		<u>Extrapolated Building(s)</u>		<u>Ratio of</u>
<u>Building Number</u>	<u>Floor Area (ft²)</u>	<u>Building Number</u>	<u>Floor Area (ft²)</u>	<u>Floor Areas</u>
12	121,400	13	121,400	1.0
		14	121,400	1.0
		23	121,400	1.0
		24	121,400	1.0
		33	121,400	1.0
		34	121,400	1.0
		73	120,000	0.989
		74	120,000	0.989
22	121,400	None	N/A	N/A
32	776,800	None	N/A	N/A
35	94,600	None	N/A	N/A
41	171,200	None	N/A	N/A
42	776,800	None	N/A	N/A
43	121,400	45	126,600	1.06
52-A	13,300	52-B	6,500	0.439
64	120,000	54	120,000	1.0
		63	120,000	1.0
72	60,800	None	N/A	N/A
82	136,000	None	N/A	N/A

Note: Building 44-B was not surveyed and is not similar to any contracted building.

SECTION 3

ENERGY CONSERVATION MEASURES (ECMs) DEVELOPED

3.1 ECMs INVESTIGATED

Using the list of potential ECMs in Annex A of the Scope of Work, previous engineering experience, and a preliminary facility field survey, a list of potential ECMs to be investigated was developed by WESTON, Inc. To this list was later added the potential ECMs of Building 32. The final list is as shown in Figure 3-1. Not all ECMs on this list met the ECIP criteria of E/C ratio greater than 10 to be included in ECIP or Increment G projects. In the EMCS feasibility study done independently by V.L. Falotico, Inc., a similar list of ECMs related to an EMCS system was developed. (For a complete list of these ECMs refer to the "Concept Submission" dated 31 December 1980 by Falotico.)

Because of the overlap of projects in the two studies, ECM costs and savings have been grouped into 3 categories:

Category A: ECMs also identified by V.L. Falotico, Inc. for proposed EMCS.

Category B: Additional ECMs for the EMCS identified by R.F. Weston, Inc.

Category C: ECMs not related to the EMCS identified by Weston.

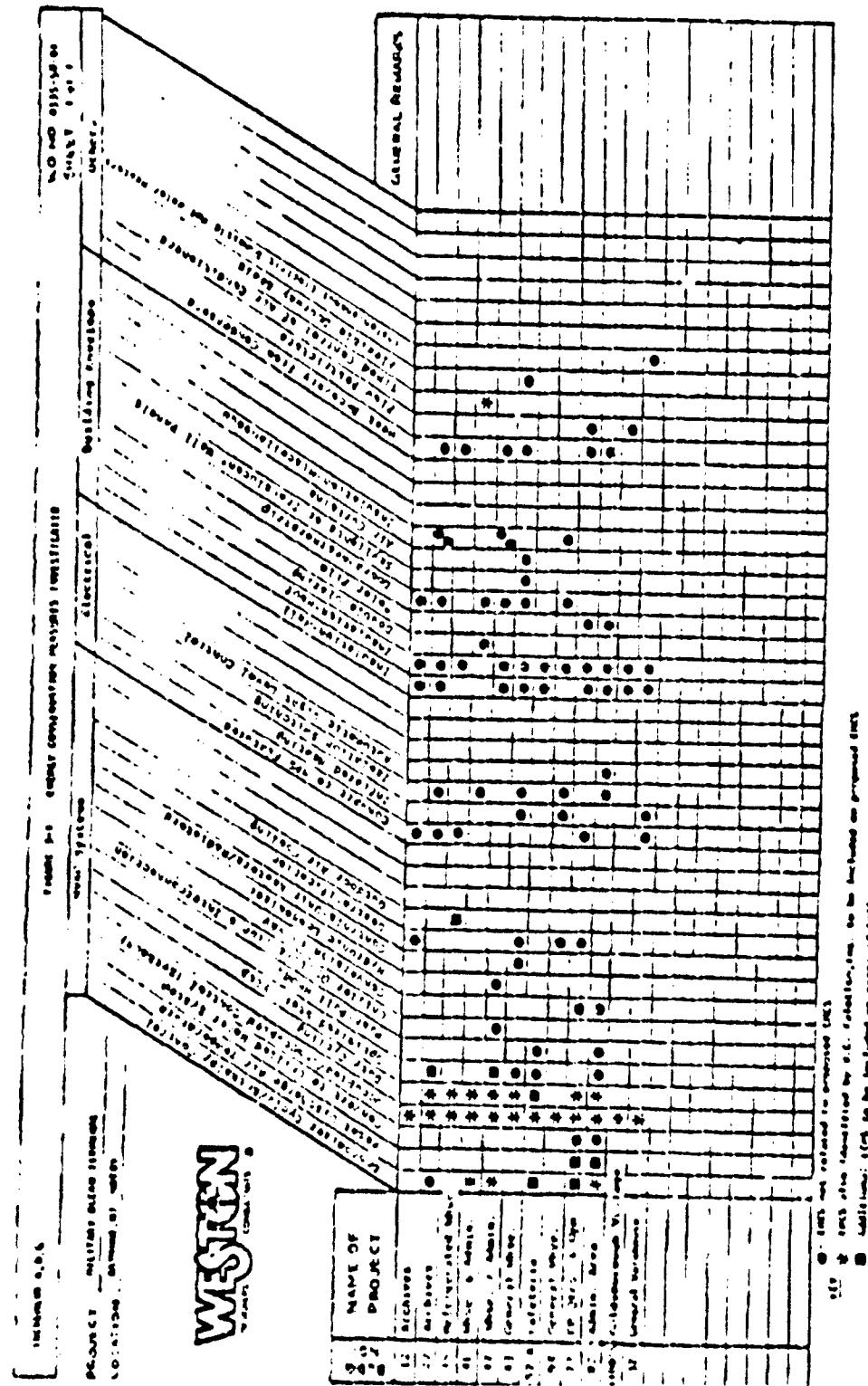
For ECMs in Category A, the costs and savings predicted by V.L. Falotico have been used. ECMs in Category A evaluated by Weston are indicated by a "w" on Figure 3-1.

The ECMs in Category B have been grouped into an Increment G project. These ECMs are indicated by a "#" on Figure 3-1.

The ECMs in Category C are indicated on Figure 3-1 by a "c".

These three categories are used when summarizing the costs and savings of all projects.

The results of the detailed ECM investigations are given in Table 3-1. The table is organized by buildings surveyed. Information included is:



1. Project cost
2. Annual Source Energy Savings (MBtu)
3. Annual Energy Cost Savings
4. Simple payback
5. B/C ratio
6. E/C ratio

From this list of potential projects only those with an E/C ratio greater than 13 were considered for implementation as ECIP and Increment G projects. Projects which were also included in the EMCS study by V.L. Falotico, Inc. were considered part of that project, and the overall costs and savings for the EMCS then apply for that particular ECM.

3.2 ECIP PROJECTS DEVELOPED

A summary of the ECIP projects developed is given in Table 3-2 from the individual ECMs. The EMCS study is the basis for one ECIP project. The individual ECMs not related to the EMCS (indicated by a '0' in Figure 3-1), and with an E/C ratio greater than 13 "are grouped together to form 6 ECIP Projects (A-1 thru A-6)". Each ECIP project preferably has a cost of \$200,000 or more.

For more detailed information on each project, including surveyed and extrapolated buildings, refer to the DD Form 1391's in Volume IV in this report.

Note that if all seven ECIP projects are implemented, the annual energy savings is 171,159 MBtu, and the annual energy cost savings in FY85 dollars is \$1,207,340. This energy savings represents 17.5% of the base year FY75 energy consumption of 979,200 MBtu. The total cost of these projects is \$4,507,000.

3.3 OTHER ENERGY CONSERVATION PROJECTS

A summary of these projects is given in Table 3-3. These projects consist of 1) Increment G projects, in which the E/C ratio for each is greater than 13, but which do not meet the \$200,000 minimum criteria; 2) parts of the ECIP projects as requested by MOTBY Facility Engineering; 3) a project from Increment F, and 4) the additional ECMs for the EMCS identified by WESTON.

Because of category 2) some duplication of costs and savings occur. The numbers in parentheses give the total projects cost and savings including duplication with the ECIP projects. The numbers not in parentheses give the additional cost and savings not duplicated. These values are the ones used for summarizing costs and savings. These projects will produce an additional annual energy savings of 3,055 MBtu and an additional energy cost savings in FY85 dollars of \$24,230.

The additional energy savings represents 0.3% of the base year FY75 energy consumption of 979,200 MBtu. The additional cost of these projects is \$103,310.

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Table 3-1 (Sheet 1 of 5)

Results of Detailed
Energy Conservation Measure Investigations

Seq. No.	Measure	Description	Investigation	Source	Energy Savings Ratio	Annual Savings	Simple Payback Yrs	S/C Savings		S/C Savings
								Simple	S/C	
12	Occupied/unoccupied control (switch)	2,376	2,376	46,200	0.7	26.2	79.3			
	Refrigeration	57,616	2,684	21,898	2.3	9.7	60.0			
	Convert to BAC filters	15,518	206	1,590	9.3	2.3	16			
	Insulation - wall	166,700	1,126	9,410	10.1	1.1	6.3			
	Insulation - roof	465,800	5,845.0	42,350	10.0	1.0	11.0			
	Door - weatherstrip	1,479	67.0	530	2.5	9.3	66.5			
13	Schneider cycle/enthalpy control	7,200	134	1,030	6.4	2.0	19.4			
	Occupied/unoccupied control (switch)	9,679	5,965	42,178	0.70	71.7	692.0			
	Door - weatherstrip	2,410	150.0	1,200	2.0	9.0	66.7			
	Insulation - wall	6,520	169	1,510	6.1	1.1	17.1			
	Insulation - roof	6,798	149.3	1,288	5.0	1.0	12.7			
	Convert to BAC filters	11,450	165	1,270	10.1	2.1	12.9			
	Insulation - roof	157,180	938	7,840	10.0	1.2	6.2			
	Door - weatherstrip	445,840	4,951.1	41,198	10.2	1.0	11.7			
	Insulate skylights	1,458	123.1	1,030	1.3	87.8	69.2			
	Insulate office ceiling	67,720	510.0	4,270	10.4	1.7	6.4			
	Heat recovery from condenser area	11,130	161.0	1,350	7.0	1.0	15.3			
	Occupied/unoccupied control (switch)	1,910	2.0	20	99.5	0.2	1.3			
14	Duty cycling	7,379	60.3	570	12.2	1.2	9.9			
	Outside air cooling	1,700	1.0	40	40.5	0.2	1.1			
	Convert to BAC filters	16,360	320.0	4,660	3.4	4.0	38.6			
	Insulation - roof	51,740	2,621.0	21,760	2.3	0.4	57.4			
	Heat recovery from condenser area	328,070	191.0	1,410	221.1	0.1	0.6			
		37,660	213.1	2,840	17.5	0.9	6.0			

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Table 3-1 (Sheet 2 of 5)

Study No.	Study Description	Design	Survey Rate	Simple Survey Rate	95% Confidence Interval	n/c	n/c
41	Residential cycle/occupant control (soilbath)	2,300	200	1,500	4.4	3.0	29.2
	Occupied/unoccupied control (soilbath)	9,600	7,956	65,600	9.10	11.0	977.1
	Barry cycling	1,119	141	1,272	2.4	5.3	49.5
	Interior wall insulation	23,115	823.5	3,213	7.4	2.0	37.9
	Shingle shoring	357,000	2,212	18,490	10.1	1.3	6.5
	Soil -- weatherstrip	1,200	100.0	914	1.4	11.3	97.7
	Field control of oil pipelines	1,700	550.0	6,310	0.4	35.5	366.4
42	Residential cycle/occupant control	23,119	763	6,650	4.0	3.4	22.0
	Occupied/unoccupied control (soilbath)	15,592	16,642	69,999	0.1	87.0	737.2
	Barry cycling	26,320	1,138	18,718	1.6	7.6	68.6
	Open-vented stack/soil	6,118	735.3	5,970	1.0	14.2	125.5
	Calliper aspiration and interconnection	17,119	95	700	20.6	9.7	2.90
	Hydronic circulation	Field study comparing measure to best possible under current operating practices. ¹					
	Insulation -- wall	707,460	6,650	55,670	13.0	1.0	0.9
	Insulation -- roof	416,370	7,279	60,760	4.6	2.7	16.7
	Soil -- weatherstrip	1,130	99.6	830	1.4	17.5	80.1
	Interior wall insulation --	Field study comparing measure to best possible under current operating practices. ¹					
	Off/low ceiling insulation	100,700	1,020.7	12,060	0.1	2.9	16.0
	Went recovery from condens-	150,110	3,011	32,610	0.1	5.2	26.2
	ers	9,480	31.4	268	14.8	0.40	1.5
43	Occupied/unoccupied control (soilbath)	19,119	7,370	61,210	0.2	62.3	522.1
	Barry cycling	16,410	1.0	10	325.0	0.0	0.20
	Open-vented stack/soil	4,790	23.0	180	25.3	0.5	5.0
	Control -- wall header/	Field study comparing measure to best possible under current operating practices. ¹					
	radiators	2,610	94	790	2.4	5.0	49.3
	Desublimation	52,168	4,129.3	36,810	1.4	16.7	81.1
	Infra-red heating	Field study comparing measure to best possible under current operating practices. ¹					

WESTON

Table 3-1 (Sheet 3 of 5)

Ref.	Occupant Volume Measure	Intervention	Source Savings MWh	Annual Savings \$/h	Simple Payback Yrs	E/C Ratio	Life Cycle Ratio
42	Insulation matching		6,260	1,030	6.3	0.9	20.6
42c-1	Insulation -- wall	275,950	1,470	11,870	27.1	1.1	5.1
	Insulation -- roof	441,710	2,954.2	26,760	16.9	1.1	7.1
	Shade -- weatherstrip	980	110.0	920	1.0	21.5	110.3
	Skylights or translucent panels	136,900	306.0	3,000	42.3	0.2	1.0
42c-2	Wall panels	46,710	659	4,410	10.4	1.0	16.4
	Skylight recovery from exterior	660	1.0	10	76.0	0.20	1.20
	Flexible recovery panels	58,380	600.1	3,364	16.6	1.0	7.30
	Exterior cycle/enthalpy	3,330	161	1,030	3.1	0.3	01.1
52-2	Controlled Occupied/unoccupied control (footback)	1,620	430	3,660	0.3	52.0	407.0
	Day cycling	2,410	51	350	0.3	1.6	15.7
	Optimized start/stop	4,740	44.0	340	12.4	1.0	6.7
	Push/pull heads	20,650	1,299.0	16,560	1.0	12.6	61.2
60	Insulation -- wall	327,120	407	3,400	16.0	1.3	1.3
	Insulation -- roof	45,540	613.5	3,500	12.4	1.3	8.7
	Occupied/unoccupied control (footback)	37,350	6,050	37,720	0.2	76.1	636.0
	Optimized start/stop Infrared sensing	37,110	3,527.0	29,520	1.0	12.9	63.0
72	Insulation matching	28,360	740	5,660	6.0	0.1	20.3
	Insulation -- wall	55,960	6,750	31,500	1.0	106.1	36.6
	Insulation -- roof	616,910	2,973.7	20,640	15.7	1.2	7.4
	Shade -- weatherstrip	930	109.1	910	1.0	21.2	117.3
72	Skylights or translucent panels	114,900	197	1,060	42.3	0.3	2.0
	Exterior cycle/enthalpy	10,780	160	1,230	0.2	1.6	15.6
	Exterior air temperature start	5,550	773	3,930	0.9	15.1	116.0
	Chart to control motor system (blinds, 72 and 60)	307,190	6,845	60,200	4.1	3.0	20.3
72	Occupied/unoccupied control (footback)	16,700	2,701.2	22,100	0.6	2.1	192.0

WESTEN

Table 3-1 (Sheet 4 of 5)

Site No.	Scour Concentration (scour coefficient)	Scour Depth inches	Scour Width inches	Scour Depth inches	Scour Width inches	B/C Ratio	B/C Ratio
72	Scour resulting from control 1) Conversion to wav breaker/levee 2) Conversion to wav breaker - wall 3) Isolation - wall 4) Isolation - roof 5) Solar site	0.150 0.160 0.900 0.150 2.000 1.00 1.00 1.750	167 1,313 3,666 212 2,243 1,224 1,224 167	1,120 10,130 4,530 2,560 10,750 10,750 10,750 10,750	1.1 6.0 1.0 5.7 2.1 16.7 1.4 6.3	2.3 16.3 20.1 22.7 2.1 16.7 7.1 2.3	20.3 116.1 21.3 21.3 2.1 16.7 7.1 2.3
	Net recovery from control area	1.400	19.6	630	1.3	11.7	90.3
	Flow restrictions	0.20	76.0	630	1.3	11.7	90.3
82	Scour resulting from control 1) Isolation of the levee 2) Conversion to control water system (SL site, 21 and 22 are completed/uncompleted areas and 20 is not built)	1.500 1,110	213 213	1,650	0.5	26.0	30.0
	Scour Building 72.						
	Scour resulting from control 1) Isolation of the levee 2) Conversion to wav breaker - wall 3) Isolation - roof 4) Solar site	0.630 0.630 0.630 0.630	7,320 60.0 129.6 312.4 105	9,601.0 310 196 1,640 1,070	176.5 11.3 6.0 5.0 1.7	134.9 6.10 1.0 2.3 1.0	1,301.0 6.10 1.0 2.3 1.0
	Net recovery from control area	0.20	76.0	630	1.3	11.7	90.3
83	Scour resulting from control 1) Isolation of the levee 2) Conversion to wav breaker - wall 3) Isolation - roof 4) Solar site	1.500 1,110 1,110 1,110 1,110	233.1 4,326 10,412 16,060 710	1,940 35,420 16,060 16,060 44.7	16.5 11.3 11.3 6.9 1.0	6.0 2.1 2.1 1.1 1.0	6.0 2.1 2.1 1.1 1.0
	Net recovery from control area	0.20	76.0	630	1.3	11.7	90.3
	Flow restrictions	0.20	76.0	630	1.3	11.7	90.3
	Scour resulting from control 1) Isolation of the levee 2) Conversion to wav breaker - wall 3) Isolation - roof 4) Solar site	0.630 0.630 0.630 0.630	279.400 3,346.0 4,576.0 1,200.0	29,660 35,250 36,700 10,700	11.4 6.5 6.5 6.5	126.0 1.0 1.0 1.0	126.0 1.0 1.0 1.0
	Net recovery from control area	0.20	76.0	630	1.3	11.7	90.3

Table 3-1 (Sheet 3 of 5)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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3.4 POLICY CHANGES/RECOMMENDATIONS

During the site visits, the Facility Engineering personnel were interviewed to develop an overview of the energy conservation policies in effect and their effectiveness in reducing energy consumption.

The results of these interviews, coupled with observations of equipment and systems, resulted in the following list of recommended policy changes:

1. The recordkeeping feature of the proposed EMCS should greatly enhance implementation of the preventative maintenance program. It is recommended that this feature of the EMCS be efficiently utilized.
2. Revision of the material and supply stock policy. This is discussed in detail in the Increment F Report, Section 3.2, and entails the implementation of a "cash reserve" to reduce an extensive inventory of spare parts.
3. Additional vehicles be provided for maintenance personnel in order to reduce waiting time between jobs. This is also discussed in detail in the Increment F Report, Section 3.2.

SECTION 4

ENERGY AND COST SAVINGS

4.1 BASEWIDE CONSUMPTION BEFORE ENERGY CONSERVATION PROJECTS

The following information on MDTBV basewide consumption is taken from Table 2-6:

<u>Fiscal Year</u>	<u>Total Basewide Energy Consumption (MBtu/yr)</u>	<u>% Reduction as % of FY75 Consumption</u>
FY75	979,200	-
FY79	885,611	9.6%
FY80	883,136	9.8%

4.2 ALLOCATION OF ENERGY CONSERVATION PROJECT SAVINGS

The energy savings of the EEAP projects are as follows. Information is summarized from Tables 3-3 and 3-4:

<u>Source of Savings</u>	<u>Annual Energy Savings (MBtu/yr)</u>	<u>% of FY75 Consumption (= 979,200 MBtu/yr)</u>
1. <u>Increments A-E</u>		
ECIP Projects A-1 thru A-6	117,669.0	12.0%
EMCS Project	52,590.0	5.5%
Subtotal	170,259.0	17.5%
2. <u>Increment G</u>		
Additions to EMCS Projects B-1 thru B-6	2,850.6	0.3%
Subtotal	20,350.6	0.021
3. <u>Increment F</u>		
All projects	19,397.0	2.0%
<u>TOTAL ALL EEAP PROJECTS</u>		
Increments A,B,C, & F	193,607.9	19.8%

4.3 PROJECTED ENERGY CONSUMPTION

With the implementation of all proposed EEAP projects, the projected FY85 basewide energy consumption is calculated as follows:

FY80 Consumption:	883,136 MBtu/yr
Total EEAP Project Savings:	<u>193,610 MBtu/yr</u>
Projected FY85 Consumption:	689,526 MBtu/yr

When compared to the baseline FY75 consumption of 979,200 MBtu/yr, this represents a reduction of 289,674 MBtu/yr, or 29.6%.

4.4 BASEWIDE ENERGY COSTS BEFORE ENERGY CONSERVATION PROJECTS

The earliest year for which basewide energy cost information is available is FY79. The energy cost in FY79, from Table 2-4 was \$3,485,534.

4.5 ALLOCATION OF ENERGY COST SAVINGS

The energy cost savings of the EEAP projects are as follows:

<u>Source of Savings</u>	<u>FY85</u>	<u>Annual</u>	<u>Energy</u>	<u>Cost Savings</u>	<u>(\$/yr)</u>
1. <u>Increments A-C</u>					
ECIP Projects A-1 thru A-6	\$ 976,754				
EMCS Project	<u>230,586</u>				
Subtotal	<u>\$1,207,340</u>				
2. <u>Increment G</u>					
Additions to EMCS	\$ 22,620				
Projects B-1 thru B-6	<u>\$ 1,616</u>				
Subtotal	<u>\$ 24,236</u>				
3. <u>Increment F</u>					
All projects	\$ 162,110				
<u>TOTAL ALL EEAP PROJECTS</u>	<u>\$1,393,680</u>				

4.6 PROJECTED ENERGY COSTS

The FY79 energy costs were \$3,485,000. The energy cost savings calculated above were escalated to FY85. To determine the projected FY85 costs, the FY79 energy costs must also be escalated to FY85. Using the Annual Fuel Escalation Rates from "ECIP Guidance" p.8-1.

<u>Escalation Year</u>	<u>Escalation Rate</u>	<u>Escalation Factor</u>
FY80	1.53	1.15
FY81	1.53	1.15
FY82	1.53	1.15
FY83	1.53	1.15
FY84	1.53	1.15

TOTAL ESCALATION FACTOR is $(1.15)^5 = 2.011$ giving the escalated FY79 fuel cost to be $3,485,000 \times 2.011 = \$7,008,000$.

The projected FY85 energy cost is therefore:

- Energy Cost Escalated to FY85 = energy cost savings.
- $\$7,008,000 - \$1,393,680$
- $\$5,614,320$

Based on FY79 this energy cost savings represents a reduction of 19.9%.

SECTION 5

INCREMENT "F" - FACILITIES ENGINEER CONSERVATION MEASURES

5.1 SCOPE

The scope of this increment is to 1) summarize the savings from increments A, B, and C and 2) make recommendations for changes in operational and maintenance procedures falling under the responsibility of facility engineering.

5.2 RESULTS AND RECOMMENDATIONS

The Increment F study has been issued as an independent report, dated January 1983, by R.F. WESTON, INC. One ECM was proposed which entailed O&M changes to buildings 12,22,35,41,42,43,52-A,64,72,82 Goldsborough Village and extrapolated buildings. The results of this ECM are summarized in Table 5-24 of the Increment F report: The project cost is \$95,192, and would produce an annual energy savings of 19,397 MBtu/yr and an annual energy cost savings of \$162,111. The E/C ratio of this project is 203.8.

SECTION 6

ENERGY PLAN

6.1 MATRIX OF ENERGY SAVINGS

The ECM's investigated were combined to produce six ECIP projects: A-1 through A-6. These projects along with the EMC3 project as analyzed by V. L. Falotico, Inc. are prioritized in Table 6-1 according to decreasing E/C ratio. The percent energy consumption reduction is also calculated in the last column. Totals for all ECIP projects are given at the bottom.

Table 6-2 gives similar information for Increment G projects and the Increment F project. Because of the overlap of some of the Increment G projects with the ECIP projects, two values for the Annual Energy Savings and for the project costs are given. The first value refers to the parts of the project not included in the ECIP projects. The second value (in parentheses) represents the value for the entire project including duplication with ECIP projects. When totals are calculated, the values for the parts not in the ECIP projects are used.

The ECIP projects are independent of each other and may be implemented concurrently or in any sequence. If implemented sequentially, the order of implementation should be by E/C ratio as in Table 6-1 for most effective energy savings; or by SIR for most effective cost savings. The ordering is the same in the case of these projects.

TABLE 6-1
PRIORITIZATION OF ECIP PROJECTS

ECIP Priority Number	Project Name	Project Cost		Annual Source Energy Savings (MWh/yr)	B/C Ratio	SIR	E/C Ratio (#Btu/KS)	Percent Consump. Reduction (Base FY75)
		Initial (\$)	Net Incl. Design (\$)					
A-4	Desulfurization	795,850	42,926.8	11.4	12.56	56.0	4.42	
A-3	Electrical Projects	474,110	22,417.4	8.5	9.49	47.7	2.52	
A-5	Insulation & Weatherstripping	775,780	33,233.7	8.5	9.34	47.8	3.42	
-	ENCS (by V. L. Folutions, Inc.)	1,790,695	\$1,690.0	1.1	Not Calculated	41.6	5.52	
A-5	Convert to Central Chilled Water System - Bldg. 77 & R2	866,470	9,845.0	5.5	7.70	38.5	0.92	
A-2	Mechanical System Modifications	146,360	5,472.0	5.2	5.72	37.4	0.64	
A-1	200' Insulation Gulf Borewell Village	197,871	6,571.6	3.7	4.10	23.1	0.52	
	Total	\$507,136	\$71,159.0	1.5	-----	38.4	17.7%	

TABLE 6-2

PRIORITIZATION OF INCREMENT C PROJECTS

Increment C Priority Number	Project Name	Annual Source Energy Savings (kBtu/yr)		Project Cost (kWh - Not incl. Design (s))	B/C Ratio	E/C Ratio (kBtu/k\$)	Percent Conserve Reduction (Base FY75)
		Energy Savings (kBtu/yr)	Annual Cost (kBtu/yr)				
B-7	Duty Cycling - Bldg. 42	0	(11,338.0)	0	(19,510)	7.6	68.6
B-1	Push/Pull Handles - Duty Cycling Bldg. 52A	0	(11,351.0)	0	(22,300)	11.1	60.6
B-3	Outdoor Air Cooling	0	(528.0)	0	(13,670)	4.0	38.6
B-5	NYAC Handles - Bldg. 87	0	(803.9)	0	(21,790)	3.9	35.0
-	Additions to EMCSS	2,850.6	93,060	3,5	30.6	0.38	
B-6	Scrammizer Cycle and Heat Recovery - Bldgs. 22 & 87	263.3	(412.0)	10,250	(15,620)	2.9	25.0
B-6	Scrammizer Cycle and Duty Cycling	0	(353.6)	0	(18,180)	2.0	18.4
	Sub-Total	3,053.9	103,310	3.1	30.9	0.38	
	Increment C Operation & Maintenance Projects	95,192.0	19,397	203.8	9.12		

Projects B-1, B-2, B-5, and B-6 are all or partially included in an ECIP project proposed in Table 3-3. The numbers in parentheses are the actual project savings and costs and include duplication with ECIP projects. The numbers not in parentheses represent portions of the project not accounted for in other projects, and are the values used for determining totals.

^a Project B-3 is included in the Additions to EMCSS.

6.2 PERCENT REDUCTIONS BY 1985

Table 6-3 summarizes the reductions using data from Tables 3-3 and 3-4 and from Section 4.

TABLE 6-3

PERCENT ENERGY REDUCTION AND CONSUMPTION FOR FY75, FY79, FY80, AND FY85

<u>Fiscal Year</u>	<u>Percent Reduction Base FY75</u>	<u>Percent of FY75 Consumption</u>
Base Year FY75	0%	100.0%
FY79	9.6%	90.4%
FY80	9.8%	90.2%
ECIP Projects (Incre. A & B)	17.5%	
Increment G Projects	0.3%	
Increment F Projects	2.0%	
	<u>19.8%</u>	
FY85 With All Projects Implemented	29.6%	70.4%

The 29.6% reduction is in excess of the 20% required, this provides the option of choosing selected projects to meet the 20% reduction requirement, or to implement them all to provide maximum savings.

6.3 ENERGY USAGE PER SQUARE FOOT BY 1985

The total floor area, in square feet, of the 43 buildings connected to the Building 44-C Heating Plant as given in Table 2-7 is 4,638,800 ft². The floor area of the four building groups comprising Goldsborough Village is 52,700 ft². This gives a total floor area of 4,691,500 ft².

Table 6-4 gives projected basewide energy usage per square foot of building floor area. These values were obtained by dividing the basewide annual energy consumption values given in Section 4 by the total building floor area.

TABLE 6-4

ANNUAL BASEWIDE ENERGY CONSUMPTION PER SQUARE FOOT OF BUILDING FLOOR AREA

	<u>Mbtu/yr</u> <u>ft²</u>	<u>Btu/yr</u> <u>ft²</u>
Baseline FY75	0.209	209,000
FY79	0.1887	188,700
FY80	0.1882	188,200
PY85 (All Projects Implemented)	0.1464	146,400

6.4 PROJECT BREAKOUTS WITH TOTAL COSTS AND ECIP RATIOS

Table 6-5 summarizes the project costs, annual energy savings, and E/C and SIR ratios of all the EEAP projects studied. Values are taken from Tables 3-3 and 3-4.

The cost and savings values for the Increment 6 projects are given in terms of 1) portion of the projects not duplicated in the ECIP projects, and 2) (values in parentheses) total project values, including duplication with parts in ECIP projects. Totals are taken using the non-duplicating values.

TABLE 6-2
PROJECT BREAKDOWNS WITH TOTAL COSTS AND ECIP RATIOS

ECIP Project No.	Project Name	Project Cost (FY84 - Not Incl. Design) (\$)	Annual Source Energy Savings (Mbtu/yr)	E/C Ratio (Mbtu/k\$)	SIR
A-1	Boil Insulation Goldsborough Village	197,871	4,574.6	23.1	4.10
A-2	Technical System Mods.	166,360	5,472.0	37.4	5.72
A-3	Electrical Projects	676,110	22,617.4	47.2	9.49
A-4	Desalification	755,850	62,926.8	56.8	12.56
A-5	Convert to Central Chilled Water System - Bldg. 72 & 82	866,470	8,015.0	10.5	7.70
A-6	Insulation & Weatherstripping	775,780	33,231.7	22.8	9.14
-	EMCS (by V. L. Falotico, Inc.)	1,290,695	\$3,690.0	41.6	Not Calculated
	Sub-Total for ECIP Projects	\$507,136	171,159.0	38.4	
<hr/>					
B. <u>Increment C</u>					
	Additions to EMCS	91,060	2,850.6	30.6	
B-1	Port/Pull Handles - Bury Cycling Bldg. 52A	0 (22,300)	0 (1,351.0)	60.6	
B-2	Bury Cycling - Bldg. 42	0 (19,510)	0 (1,338.0)	68.6	
B-3	Outsour Air Cooling	0 (13,670)	0 (528.0)	38.6	
B-4	Economizer Cycle and Heat Recovery - Bldgs. 22 & 82	10,250 (15,620)	203.3 (612.0)	25.0	
B-5	W/HAC Mods. - Bldg. 82	0 (21,790)	0 (803.9)	35.0	
B-6	Economizer Cycle and Duty Cycling	0 (18,360)	0 (353.6)	18.4	
	Sub-Total Increment C	<u>\$93,310</u>	<u>3,053.9</u>	<u>30.9</u>	
B-7.	<u>Increment F</u> Operation & Maintenance Proj.	<u>\$5,192</u>	<u>19,397.0</u>	<u>203.8</u>	
B-8.	TOTAL ALL PROJECTS	\$6,705,618	193,609.9	61.1	

6.5 GRAPHIC REPRESENTATION OF PRESENT AND PROJECTED ENERGY USE

Present (FY79) and projected energy use with EEAP energy projects is calculated by fuel type in Table 6-6. The results of these calculations are presented graphically in Figures 6-1 and 6-2:

Figure 6-1 (Pie Chart): Presents Annual energy consumption by fuel type for 1) FY79 (the first year detailed data was available) and 2) FY85 if all EEAP projects are implemented. Savings are indicated by the hatched areas. Percentages are in terms of FY79 consumption.

Figure 6-2 (Bar Chart): The same information is presented as in Figure 6-1, but in addition total consumption is for FY79 and FY85 is directly compared, as is total oil consumption.

Note: The percent reduction in Figure 6-1 of 21.8% differs from the 19.8% reduction given in Section 6.2. This difference is due to the fact that FY79 is used as the base year in Figures 6-1 and 6-2 whereas FY75 is used as the base year in Section 6.2. FY79 is the earliest year for which data for energy consumption by fuel type is available.

1986-87

1986-87 1987-88 1988-89 1989-90 1990-91 1991-92
1986-87 1987-88 1988-89 1989-90 1990-91 1991-92

1. Energy Projects - 1986-87, 1987-88, 1988-89

Energy Proj. cat.	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93
I. E&P Projects							
1-1	0.0	0.376.0	0.376.0	0.0	0.0	0.376.0	0.0
1-2	1,367.0	1,308.0	1,367.0	2,326.0	0.0	3,472.0	3.0
1-3	10,109.1	0.0	10,109.1	10,610.0	0.0	21,617.0	2.0
1-4	45,001.1	0.0	45,001.1	47,075.0	0.0	61,910.0	4.0
1-5	0.0	0.0	0.0	8,045.0	0.0	8,045.0	1.0
1-6	35,213.2	0.0	35,213.2	0.0	0.0	35,213.2	3.0
1-7	46,897.0	1,319.0	46,897.0	7,190.0	0.0	53,690.0	0.0
II. Incremental Projects							
2-1	312.0	0.0	312.0	2,338.0	0.0	2,650.0	0.0
2-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-4	200.0	0.0	200.0	0.0	0.0	200.0	0.0
2-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III. Remaining Projects							
	10,652.0	0.0	10,652.0	70.0	0.0	10,652.0	0.0
TOTALS	156,000	1,340	156,000	29,330	0.0	152,610	31.0

Figures for 1986-87 for these projects are included in E&P projects of the 1986-87 and 1987-88 Periods as given here to avoid duplication.

2. Utilities

Total Other	157,200.0	17,200.0	174,200.0	190,000	21,000	205,000
Cost Total	62.98	1.91	64.98	32.98	3.91	32.98

3. Miscellaneous - 1986-87, 1987-88, 1988-89

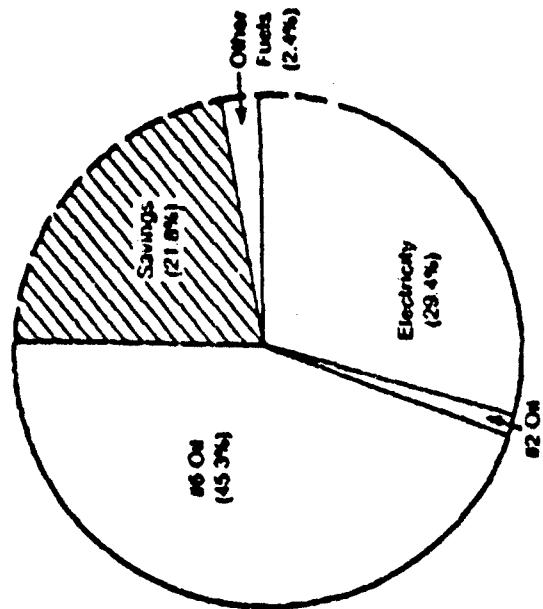
Total Other	400.00	0.00	400.00	360,072	21,000	391,072
Cost Total	0.00	0.00	0.00	29.00	0.00	29.00

General Fuel Type	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92
Gasoline	90,740.601	10.00	1,601	0	10,740.601	0
Diesel Fuel	38,036.601	5,010	1,501	0	39,536.601	0
Gasohol	12,319.600	1,210	1,210	0	10,319.600	0
Propane	3,009.601	0.00	1,501	0	3,509.601	0

TOTAL = 149,785.601 = 0.0 169,691.601

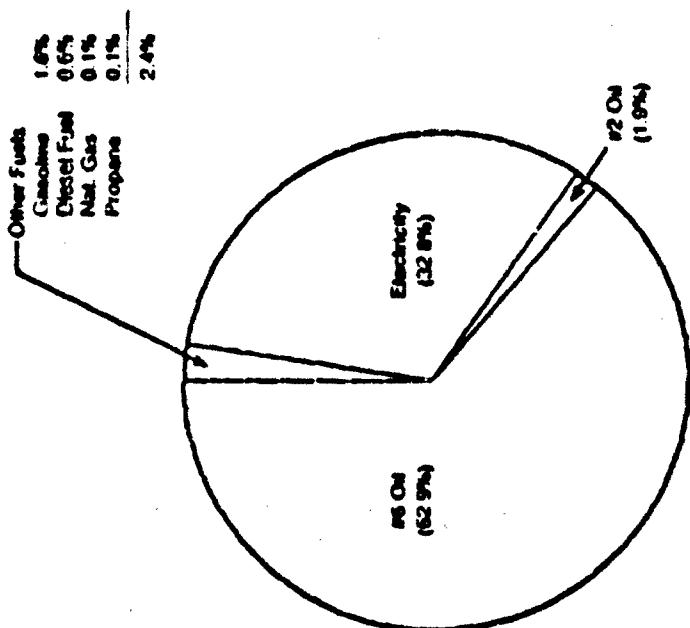
TOTAL = 0.0 169,691.601 = 0.0 169,691.601

WESTERN



Projected Energy Use with EEA Energy Projects

Total: 692.0×10^6 BTU - 78.2%



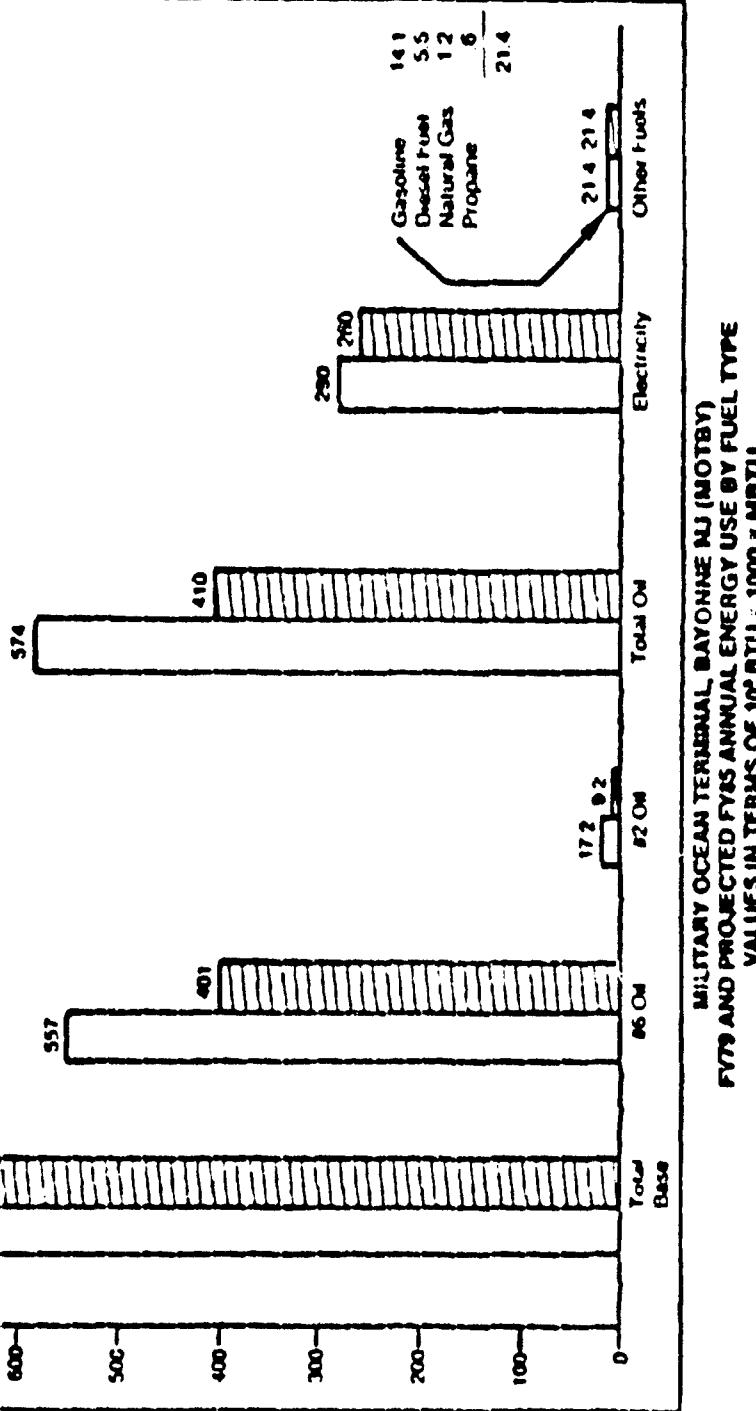
FY79 Energy Use

Total: 885.6×10^6 BTU - 100%

MILITARY OCEAN TERMINAL, BAYONNE, NJ (MOTBY)
FY79 AND PROJECTED FY83 PERCENTAGE OF ANNUAL ENERGY USE BY FUEL TYPE

WESTEN

Present Energy Use-FY79
Projected Energy Use FY85 with
EEAP Energy Projects





DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING STATION, CHAMPAIGN, ILLINOIS
PAKISTAN
CHAMPAIGN, ILLINOIS, U.S.A.

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